EDITORIAL

Interview with Lawrence Weed, MD—The Father of the Problem-Oriented Medical Record Looks Ahead

Lee Jacobs, MD

I first met Lawrence Weed, MD, in 1972 when I was a third-year medical student at the University of Vermont. To this day I remember his passion for a disciplined approach to medical record documentation to optimize the care provided to each individual patient.

Now, 35 years later, I was privileged to meet with Dr Weed at his home in Vermont. We discussed when he first was alerted to the nonscientific approach clinicians use to make decisions on patients. The rest of the interview time was spent with Dr Weed teaching me about the solution that he has spent the last 30 years designing and implementing.

This interview is published to complement the editorial in the most recent issue of *The Permanente Journal* (Spring 2009;13[2]:85-7). We believe that in the era of health care reform and quality improvement initiatives, it is important that the medical community take a close look at Dr Weed's total approach decision-making information support defined in this interview.

— Lee Jacobs, MD

The Genesis of the Problem-Oriented Medical Record— *The Journey Begins*

Lee Jacobs, MD (LJ): First Dr Weed, could you take us back to the beginning when you first realized that physicians needed the problem-oriented medical record (POMR)?

Lawrence Weed, MD (LW): The true depth of the knowledge problem in medicine occurred to me when I found myself doing basic research in biochemistry at a university medical school. As a scientist in the laboratory I was dealing with one problem at a time, making time and tasks the variable and achievement the constant. When I understood the problem, I wrote up my findings, had them audited and revised when necessary, and finally published in a journal.

During this time doing research, because of my clinical background and combined appointment on the faculty, I was asked to teach clinical medicine on the wards a couple months a year. It was at this point that the true nature of our predicament dawned on me.

As I wrote in 1969, "The beginning clinical clerk, the new intern, and the practicing physician are confronted with an apparent contradiction. Each is asked, as a 'whole' physician, to accept the obligations of meeting many problems simultaneously and yet to give to each the single-minded attention that is fundamental to developing and mobilizing his or her enthusiasm and skill, for these two virtues do not arise except where an organized concentration upon a particular subject is possible."[1]

The multiplicity of problems the physician must deal with every day constitutes a principal distinguishing feature between a physician's activities and those of many other scientists.

These realizations led me to develop the POMR so that medical students and practitioners could function in a structured, rigorous way more like that of workers in the scientific community. The POMR cannot change the multiplicity of problems that physicians face. But the POMR enables a highly organized approach to that complexity.

LJ: Not uncommonly, individuals have ideas on how to improve a system but are unable to get their innovation adopted. Tell us how your idea on the POMR went from a concept to being implemented worldwide as a standard for medical documentation.

LW: Although I would like to believe that my traveling and lecturing around the country and abroad helped promote the POMR, we must recognize the enormous contribution of Harold Cross, MD, in Hampden, ME. He set up a problem-oriented medical practice after an internship at the Eastern Maine General Hospital in Bangor, ME, where I first started the POMR as Medical Director of the hospital. Dr Cross was joined in his office by

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John Bjorn, MD, and later Charles Burger, MD. Together they created a practice model for their office that demonstrated for the world what a problem-oriented system could do. The medical community needs to see that an innovation is indeed successful in a medical practice before they consider adopting it.

LJ: I remember visiting their office in Hampden, ME in the early 1970s. It was truly an amazing demonstration of the value of the POMR. For example, I recall how they tracked their patients' problems so well that they were able to retrieve all patient records for a given problem and would periodically invite specialists to review those records and assess how they handled various disease entities. It was an impressive quality improvement approach—all made possible because of their discipline in applying the principles of the POMR.

Could you tell our readers how this innovation in record keeping moved from the outpatient practice demonstration of Drs Cross, Bjorn, and Burger to become accepted in academic settings?

LW: A most important contribution was from Franz Inglefinger, MD, the Editor of the *New England Journal of Medicine (NEJM)*. He had heard about my rounds and lectures on the Harvard service at the Boston City Hospital and so, in 1968, he asked me to write the article in *NEJM* entitled "Medical Records that Guide and Teach."[2]

Equally important was the contribution made by two leaders in American medicine, Willis Hurst, MD, and his coworker Kenneth Walker, MD, in Atlanta, GA. Not only was Dr Hurst a chairman of a department of medicine in a leading medical school [Emory], he also authored major medical textbooks. In 1971, he took the time to write an editorial in *NEJM* entitled "Ten Reasons Why Lawrence Weed is Right"[3] and then proceeded to set up two major conferences on the POMR for people from all over the country to attend.[4,5]

It was this combination of demonstrating value in an actual medical practice along with publication in a major medical journal and leadership by respected clinicians that led to the POMR being adopted worldwide.

Life Beyond the Problem-Oriented Medical Record—*The Next Challenge*

LJ: Practitioners worldwide adopted your problem-oriented approach to medical records. When the POMR came into common use, were you satisfied at the time that the POMR would be the final solution for the information dilemma you first encountered on the wards as an attending?

LW: No. The POMR surfaced the need for new tools to move knowledge differently when caring for a patient. Accordingly, during the 1970s, I led an effort to develop an electronic version of the POMR designed to solve the problem of information retrieval.

However, solving the retrieval problem with computers uncovered an even greater processing problem—integrating detailed patient data with comprehensive medical knowledge. Computer technology maximized access to voluminous data and knowledge, thereby exposing the limited information processing capacity of the human mind. Scientists cope with this limitation by controlling the research environment, defining the variables involved, and limiting the scope of their investigations. Practicing physicians do not have that luxury. The time constraints of practice and the enormous scope of information implicated by multiple problems in unique patients make it impossible for the human mind to function with scientific rigor. Physicians inevitably resort to dangerous cognitive shortcuts.

I realized that medicine must transition from an era where knowledge and information processing capacity resides inside a physician's head to a new day where information technology would provide knowledge and the processing capacity to apply it to detailed patient data. The physicians' unaided minds are incapable of recalling all the necessary knowledge from the literature and processing it with data from the unique patient. An epidemic of errors and waste is occurring as we persist in trying to do the impossible. Changing this requires that we recognize the crucial distinction between electronic *access* to information and electronic *processing* of information. This requires a rational standard of data organization in medical records. Yet, these points are still not recognized in most current discussions of health information technology.

As a result, I have been involved for the last 60 years in trying to design and develop a medical care system in which patients are no longer dependent on the limited, personal knowledge their caregivers happen to possess. The medical care system must resemble the transportation system, where consumers use knowledge captured in maps, road signs,

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"It is important to understand that the discipline imposed by the POMR has not been fully embraced. Too often the POMR is sporadically employed as a convenience, not consistently enforced as a discipline. One reason is that medical education is fundamentally incompatible with the underlying philosophy of the POMR. Medical education seeks to instill medical knowledge and "clinical judgment." In doing so, medical schools give students a misplaced faith in the completeness and accuracy of their own personal store of medical knowledge and the efficacy of their intellects. What is done to students in medical school is the antithesis of a truly scientific education."

— Lawrence Weed, MD

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computerized navigation devices, and the like at the time of need. Patients, like travelers, will be expected from childhood on to develop the necessary skills to navigate the system.

At all times, patients should be supported by caregivers who are highly trained in the necessary hands-on skills, like removing the appendix or listening to heart sounds, just as in the travel system there are pilots, mechanics, air-traffic controllers, and others who perform functions that travelers cannot perform.

LJ: At national conferences I have heard you eloquently make the case that the present practice of medicine is flawed in that it primarily depends on the physician's limited memory and processing capacity when dealing with complex patient issues. What is your solution?

LW: To deal with this reality I have spent more than 30 years developing and implementing what I have called "knowledge couplers." Medical knowledge is used to select and analyze patient data, coupling the data in a matrix fashion with medical knowledge developed through research. The output of this coupling process is an organized display of options and evidence. This is far superior to that derived from a physician's memory or analysis.

Although there may be other similar tools available, I can assure you that any automation that reliably couples patient data with the world's medical research will be dramatically better than the unaided human mind.

LJ: I want to make it clear to the readers and in the spirit of full disclosure that your intent today is to advocate reforms in medical practice, including, but not limited to, the use of such tools as the knowledge couplers, rather than promote an approach from which you would have financial gains. Is that true?

LW: Yes. It is also true that I could gain financially if the knowledge coupling software that my colleagues and I first developed were to be widely adopted. However, that software is just a particular implementation of the generic concept of an electronic tool for applying medical knowledge to patient data. Others are free to build and disseminate their own implementations of the concept.

It is crucial to understand, however, that software of this kind is just one of three basic elements of reform that I advocate. The other two elements are the POMR and reform of medical education and credentialing. The POMR is essential not only for patient care itself but also for feedback on the medical knowledge captured in knowledge coupling tools.

LJ: So you are saying that these computer-supported couplers that you have described should not be used separate from the POMR?

LW: Absolutely. Couplers are a software tool that should be directly linked to the POMR. If couplers and the POMR are not linked, the full potential of each will never be realized.

The Coupling Process—*How do Knowledge Couplers Really Work?*

LJ: Could you give us an example of how knowledge couplers might help a physician in decision making? How do they work?

LW: Let's use an acute abdomen as an example. Careful review of the literature shows that investigating this symptom should take into account scores of diagnostic possibilities that involve most medical specialties. Each diagnostic possibility can be represented in software as a combination of simple, inexpensive findings from the history, physical, and basic laboratory tests. Checking all of these items for all of the diagnostic possibilities yields a set of positive findings on a given patient. Each positive finding suggests one or more diagnostic possibilities. The software matches each patient's particular combination of positive findings against all of the combinations of findings representing the diagnostic possibilities for a patient with an acute abdomen problem. This matching process yields a set of diagnostic possibilities along with the patient's positive and negative findings for each. These findings constitute initial evidence for and against each possibility. The possibilities for which at least one positive finding is made are the diagnoses worth considering for that patient. Those possibilities for which no positive finding is made are not worth considering for that patient.

By comparison, physicians rarely use computer software to assemble patient data and medical knowledge into options and evidence for medical decision making. Instead, physicians rely largely on personal intellect—"clinical judgment"—for this pivotal function. Therein lies the flaw.

LJ: As a consultant, you have reviewed many charts and over the years you have led many patient care rounds. Do you have an example that especially stands out for you in which the physician's recall of facts was inadequate in arriving at a correct diagnosis?

LW: Here is one of many possible examples. A case that was described to me after the fact involved an eight-year-old girl complaining of severe abdominal pain. She was admitted to an emergency room at a teaching hospital. Two physicians saw her and noted a normal abdominal examination. Vomiting was also noted but not discussed. The girl's national origin,

however, led the physicians to observe that she had a "Mediterranean temperament" suggesting that her complaints may be an overreaction to a little gastroenteritis. The physicians concluded she could go home. Fortunately the nurses thought the girl's vomiting was excessive for simple gastroenteritis. Rather than allowing her to go home, the nurses elected to wait for the next shift when a new set of physicians could see the girl. Two new physicians focused on possible right lower quadrant pain, diagnosed appendicitis, and took her to the operating room. Surgery revealed not appendicitis but intestinal obstruction.

What would have happened in this case if the physicians or the nurses, or the patient's own family had used computerized support such as the knowledge couplers? Since couplers were not used at the time of this patient's encounter, the best way to answer this question is to enter the limited data available from the girl's medical record into the knowledge coupler for diagnosis of "acute abdomen." The coupling of the girl's medical record data with the coupler's database of medical knowledge results in a list of possible diagnoses suggested by one or more of the findings on the girl, together with evidence, positive and negative findings, for and against each possibility. Also included are additional findings to check, along with commentary useful for evaluating the evidence and weighing the possibilities.

One of the possible diagnoses suggested by the coupler was appendicitis, but it was a poor match with the medical record findings entered in the coupler software with only one finding consistent with this diagnosis. The diagnostic possibility that best matched the findings was small bowel obstruction.

In short, the correct diagnosis could have been easily identified in the first 15 minutes of care. What happened instead was 4-6 hours of delay in the emergency room, with two mistaken diagnoses along the way, before surgery was undertaken. The associated suffering, risk, expense, and waste entailed by reliance on the physicians' clinical judgment were unnecessary.

LJ: You mentioned at the beginning of this dialogue that one reason that the POMR caught on was because people could see how it worked in a real life medical practice in Hampden, ME. Are there similar demonstrations of the knowledge couplers in practice?

LW: Absolutely. With regard to the introduction and spread of knowledge couplers we must recognize what Kenneth Bartholomew, MD, has accomplished building a working model of his small practice in Faulkton, SD. He has written a classic article in a chapter in my book on the knowledge couplers.[6] This model led to the very important work of Dr Charles Burger, who set up a practice in Bangor, ME, based on knowledge couplers and POMR. Additionally, Dr Bartholomew has an exciting proposal that would integrate couplers communitywide in both ambulatory as well as hospital care settings. If funding is forthcoming, this could provide the nation with a major pilot project demonstrating what we should be doing around the country.

Medical Education—*Medical Student Recruitment and Education*

LJ: Let's build on this discussion of the flaws of decision making when based on the physician's memory. You have expressed concerns with both the type of individual accepted in medical school as well as how medical students are taught in their first two years. Could you tell our readers what you see as the issues and the implications to preparing these students to practice medicine?

LW: Today, students are recruited on the basis of how well they memorize and regurgitate facts. In the future because knowledge will be in information technology tools instead of in heads, students should be trained in the reliability of performance of given tasks that will be part of a complete medical care system. Students should be selected for their hands-on skills and interpersonal skills and not on the basis of their memory and regurgitation of facts. They should be required to acquire competence in discrete skills and procedures, and their licenses to practice should be correspondingly limited. Medical education should become a system of teaching a core of behavior instead of a core of knowledge.

LJ: So instead of memorizing the Kreb's Cycle, students should learn how to solve patient problems, relying on information tools and not having to recall a myriad of facts. Is that a good summary?

LW: Absolutely. Have you ever wondered why PhDs instead of MDs teach the first two years of medical school? It is because the first two years are consumed with transmitting abstract knowledge that is not effectively coupled with medical practice.

LJ: When these medical students trained in medical problem solving graduate, do you envision that the world in which they will practice would be different from today?

LW: It will be very different. The practice of medicine must become a defined and coordinated system of tasks and reliable performers—just like the airline system is a combination of pilots, mechanics, radar-skilled performers, and others, along with educated consumers who learn their roles from childhood on. The

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present system of medical schools teaching knowledge and graduating physicians performing as they do now will become an anachronism.

LJ: Your writings make a very compelling argument for these changes in medical education. Yet, such changes are largely absent from health reform debates. Why do you think there has been such a complete lack of a dialogue on the subject? If educators disagree, why aren't they saying so?

LW: The system that I just described is very threatening to many educators who are now in the business of moving knowledge through heads instead of using information technology such as knowledge coupling tools. They are judging students on how much they know instead of how well they perform in a well-defined and audited system of care. Medical educators just don't understand the need to change. It is like trying to sell airplanes to those who own the railroads.

If change is to come, it will take courageous leadership from present day Ingelfingers and Hursts.

LJ: Let's say that medical educators and practitioners come to the point of accepting the limitations of the human mind and want to incorporate knowledge couplers and the POMR standard of care into the training and practice of medicine. What might this new culture look like?

LW: I would envision a national library of knowledge couplers integrated with computerized POMR. The couplers would be constantly updated as new knowledge is harvested from the structured medical records and from the work of scientists working in laboratories. Everyone in the medical community, including patients and all caregivers in outpatient and inpatient settings, would use updated knowledge couplers to make clinical decisions.

Reform of medical education and credentialing is essential to change how caregivers function, to open the marketplace to competition by nonphysician practitioners, and to allow provider organizations to redesign medical practice.

Knowledge Couplers and Evidence-Based Medicine—*What's the Difference?*

LJ: As you know, the last decade in clinical practice support has given birth to a discipline called *evidence-based medicine* (EBM). How are automated tools such as knowledge couplers different from EBM and practice guidelines?

LW: Both are fundamentally supported by medical literature. However, EBM is based on a misguided use of statistical knowledge instead of the unique set of details from a given patient. A truly EBM system could develop if evidence would be used to individualize care rather than standardize it.

Physicians are increasingly expected to apply knowledge derived from large population studies and clinical trials. Referred to as *evidence-based medicine,* this approach is rightly intended to prevent physicians from following arbitrary local practices and unsupported personal judgments. But this approach systematically excludes the individualized knowledge and data essential to patient care.

As an example, consider the following case described in a January 1996 *NEJM* article.[7] The patient complained of severe fatigue. For months, many thousands of dollars were spent, and the patient almost died. Yet, the correct diagnosis—Addison's disease—could have been made at the outset of care using the right tools in a defined system. The physicians involved did not even consider Addison's disease until the patient was near death. Addison's disease would be a low priority for investigation in an evidence-based ranking of diagnostic possibilities, because, statistically, it is rare in the general population. Moreover, in this patient no single finding seemed specific to Addison's disease. But the patient's *combination* of findings, such as fatigue, hypotension, weight loss, abnormal pigmentation, dehydration, nausea, and abdominal pain, were highly specific to Addison's disease. If patients with this combination of findings are viewed as a subpopulation, then it becomes obvious that Addison's disease is common, not rare, for that population. But the medical literature cannot individualize the evidence in this way. A new kind of information tool is needed for practitioners to recognize the associations between individual combinations of findings and relevant medical knowledge.

This applies to therapeutic as well as diagnostic decision making. No one would expect travelers to conform to some "evidence-based" determination by experts of the "best" route across the country. The best route depends on individual characteristics, needs, and preferences. Similarly, in medicine, no one should think that two different people labeled with the "same" disease necessarily have comparable medical needs. Nor should we think that the care of unique individuals must conform to "evidence-based" guidelines derived from large population studies. Rather, high-quality, efficient care would emerge case by case, in a progression of many small steps, each one carefully chosen and reliably executed.

LJ: Sounds like you agree with a recent editorial in the *Journal of the American Medical Association* (*JAMA*)[8] in which the authors concluded "Guidelines are often too narrowly focused on single disease … and few if any guidelines help clinicians

in managing complexity." They go on to state what you just did that "Guidelines are not patient-specific enough to be useful and rarely allow for individualization of care." I guess you would applaud such a statement.

LW: Absolutely. EBM in its present form is slow and unfit to move from the population-based generalizations of medical knowledge to the remote and heterogeneous instances of unique patients. Moreover, EBM leaves unsolved the "needle in a haystack" problem—the difficulty of coupling vast knowledge with detailed data to find the crucial combinations of details relevant to an individual patient.

Because the mind more readily comprehends generalities about large populations than detailed data about individual variation, EBM is oriented toward population-based forms of evidence that poorly describe the realities of unique individuals. Indeed, that orientation characterizes medical knowledge in general.

A Final Question

LJ: Dr Weed, you have had an amazing career implementing a needed change in how patient data is handled through the POMR. Today, you outlined another major change that needs to be incorporated if the practice of medicine is to be improved. On the basis of your experience as an innovator, and knowing what you know today about medical education and the practice of medicine, are you optimistic such changes will be forthcoming?

LW: Based on what I know about all the vested interests in the present medical education system and in the present practice of medicine, I am not optimistic such changes will be forthcoming.

For change to occur, it will take extraordinary leadership with the power to switch all the capital and resources now going into a misguided form of medical education to a National Library of Couplers and a whole new paradigm for medical education and practice as described in Section VIII of the *Medicine in Denial* paper. A paradigm in which knowledge is in tools instead of heads, in which patients from childhood on are involved in the use of those tools in their own care, and in which there is a new division of labor among clinicians.

If change is to come, it will take courageous leadership from present day Ingelfingers and Hursts. If the medical establishment and the government fail to lead the change, then patients will demand such a change once they understand the deep faults in the present system.

LJ: Do you believe people will heed your warning?

LW: There were many warnings of the disaster coming in the financial system and all were ignored. The present health care system is a medical and financial disaster, and perhaps only the disaster itself will get bad enough to change the status quo. My fear is that the government will spend billions computerizing the present chaos and will remain unaware of the fundamental changes that are so badly needed.

LJ: Thank you Dr Weed. ❖

For a preview of Dr Weed's newest, unpublished book manuscript, view chapters 1, 4 and 7, at http://xnet.kp.org/permanentejournal/sum09/medicine-in-denial.pdf.

Please note: The Permanente Federation and the Permanente Medical Groups do not endorse or oppose the opinions or ideas expressed in this book.

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"The sole cause and root of almost every defect in the sciences is this: that whilst we falsely admire and extol the powers of the human mind, we do not search for its real helps."

— *Novum Organum: Aphorisms* [Book One], 1620, Sir Francis Bacon

"Medical education and medical practice ignore a truth grasped by Francis Bacon 400 years ago. A root cause of a major defect in the health care system is that, while we falsely admire and extol the intellectual powers of highly educated physicians, we do not search for the external aids their minds require."

— Lawrence Weed, MD

"She could not eat or sleep, grew visibly thinner, coughed, and, as the doctors made them feel, was in danger. They could not think of anything but how to help her. Doctors came to see her singly and in consultation, talked much in French, German, and Latin, blamed one another, and prescribed a great variety of medicines for all the diseases known to them, but the simple idea never occurred to any of them that they could not know the disease Natásha was suffering from, as no disease suffered by a live man can be known, for every living person has his own peculiarities and always has his own peculiar, personal, novel, complicated disease, unknown to medicine—not a disease of the lungs, liver, skin, heart, nerves and so on mentioned in the medical books, but a disease consisting of one of the innumerable combinations of the maladies of those organs."

— *War and Peace,* Book Nine, Chapter 16, 1869, Leo Tolstoy